A new land planarian species of the genus *Othelosoma* (Platyhelminthes: Tricladida: Terricola: Rhynchodemidae) from the eastern highlands of Zimbabwe

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A new species of rhynchodemid flatworm, *Othelosoma nyanga,* is described from Rhodes Nyanga National Park in the eastern highlands of Zimbabwe. Live flatworms are yellow, with a faint dark central line dorsally and appear cylindrical in photographs. They were found under dead wood stumps in grassland. Preserved worms are cylindrical, and up to 22 mm long and 2.5 mm wide. A dorsal anterior retractor muscle causes the head to be strongly retracted in preserved specimens. Ventrally, there is a narrow, ciliated creeping sole. There is well-developed parenchymal longitudinal musculature. Ovaries are anterior. The two ovovitelline ducts fuse posterior to the gonopore and form two further ducts. One short duct runs anteriorly and opens into the common antrum, above the gonopore. The other runs posteriorly, with a short connection to a large bursa, and continues posteriorly before entering the rear of the common antrum. The penis is exceptionally long and extends into a posterior extension of the antrum.

Key words: terrestrial flatworm, Platyhelminthes, Terricola, *Othelosoma*.

INTRODUCTION

Marcus (1955) and Jones (1998, 2004) listed the African land planarian fauna. All native African species possess a single pair of eyes and are thus of the family Rhynchodemidae, although other families have been introduced into Africa from other continents. In November 1997 and again in December 1999, some predominantly yellow land flatworms (Fig. 1) were collected and photographed near Mare Dam, Rhodes Nyanga National Park, Zimbabwe by M.S.C. They were preserved and sent to H.D.J. for identification. They are rhynchodemids but do not have the characteristics of any described species. They are thus described as a new species.

METHODS

The preserved specimens (one in formol saline, the remainder in 70% alcohol) were examined intact and after clearing in cedarwood oil. Line-drawings were made using a stereo microscope equipped with a drawing tube. One mature specimen was selected for sectioning; anterior and posterior portions were sectioned longitudinally while the central portion was cut transversely. Unfortunately, technical problems meant that a second specimen had to be partially sectioned in order to elucidate certain details. After wax embedding, 10 μm serial sections were cut, stained in haematoxylin and eosin and mounted in Canada balsam. Drawings were made using a camera lucida. Sections were photographed using a digital microphotomicroscope.

Key to abbreviations on figures: adep = anterior depression due to retractor muscle; adiv = anterior diverticulum of gut; at = common antrum; b = bursa; b-co = apparent opening of bursa to common ovovitelline duct; co = common ovovitelline duct; div = lateral gut diverticulum; e = eye; ed = ejaculatory duct; gp = gonopore; m = mouth (pharyngeal aperture); od = ovovitelline duct; odf = fusion of ovovitelline ducts; od-at = duct from junction of ovovitelline ducts to antrum; ov = ovary; p = penis; pa = parenchyma; ph = pharynx; phc = pharyngeal cavity; php = wall of pharyngeal pouch; pm = annular zone of parenchymal muscle; rh = subepidermal rhabdite layer; rm = retractor muscle; s = creeping sole; sd = sperm duct; sd-ed = sperm ducts discharging into the ejaculatory duct; t = testis; vnc = ventral nerve cord.

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Fig. 1. *Othelosoma nyanga*. Photograph of a living worm, anterior end nearest the camera (original in colour by M.S. Cumming), on the damp underside of a tree stump, among soil, fungi, grasses and roots of small plants. Length (estimated from preserved length) approximately 40–50 mm, width about 1 mm.

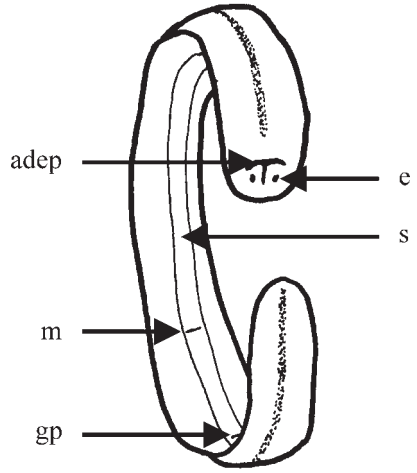

Fig. 2. Drawing of a preserved paratype, after clearing. Length about 22 mm, width about 2.5 mm. See Methods for a key to abbreviations.

TAXONOMY

(The definitions of taxa are abbreviated from Ogren & Kawakatsu 1988, 1989.)

Order Terricola Hallez, 1890

Family **Rhynchodemidae** Graff, 1896

Two eyes; elongate, cylindrical body with tapered anterior (no tentacles or expanded head).

Subfamily Microplaninae Pantin, 1953

Weak subepidermal longitudinal muscle fibres not in bundles; penis papilla present.

Genus *Othelosoma* Gray, 1869

Rounded, elongated body, anterior may be blunt or inrolled. Narrow creeping sole almost reaches anterior tip. Very large seminal bursa which communicates by two openings (or by a common opening with two canals), a ductus vaginalis and a Beauchamp's canal, leading into the genital antrum. Dorsal anterior parenchymal musculature is very highly developed and may be differentiated as a discrete retractor muscle.

***Othelosoma nyanga* n.sp.**, Figs 1–7

Material examined. Holotype. Preserved length about 22 mm, width about 2.5 mm, height about 2 mm. Posterior half sectioned longitudinally on 12 slides. Remainder preserved. Deposited in the Natural History Museum, London, accession number 2004.2.11.16. *Paratypes.* One specimen, preserved length about 22 mm, width about 1.8 mm, height about 1.5 mm. Mouth and gonopore respectively about 14 mm and 18 mm from the anterior end. Posterior (including pharynx and copulatory apparatus) sectioned longitudinally (six slides, sections badly folded). Small mid-body portion transversely sectioned (four slides). Anterior portion longitudinally sectioned (three slides). Three further preserved specimens, lengths about 15 mm, 15 mm and 12 mm. Natural History Museum, London, accession numbers 2004.2.11.17–20.

The first specimen was collected on 23 November 1997. The four other specimens (including both sectioned specimens) were collected between 1 and 9 December 1999.

Type locality. Mare Dam, Rhodes Nyanga National Park, (Eastern Highlands), Zimbabwe, 18°17′20″S, 32°46′10″E, altitude 1950 m.

Etymology. After Nyanga, the type locality.

External features. Preserved specimens are

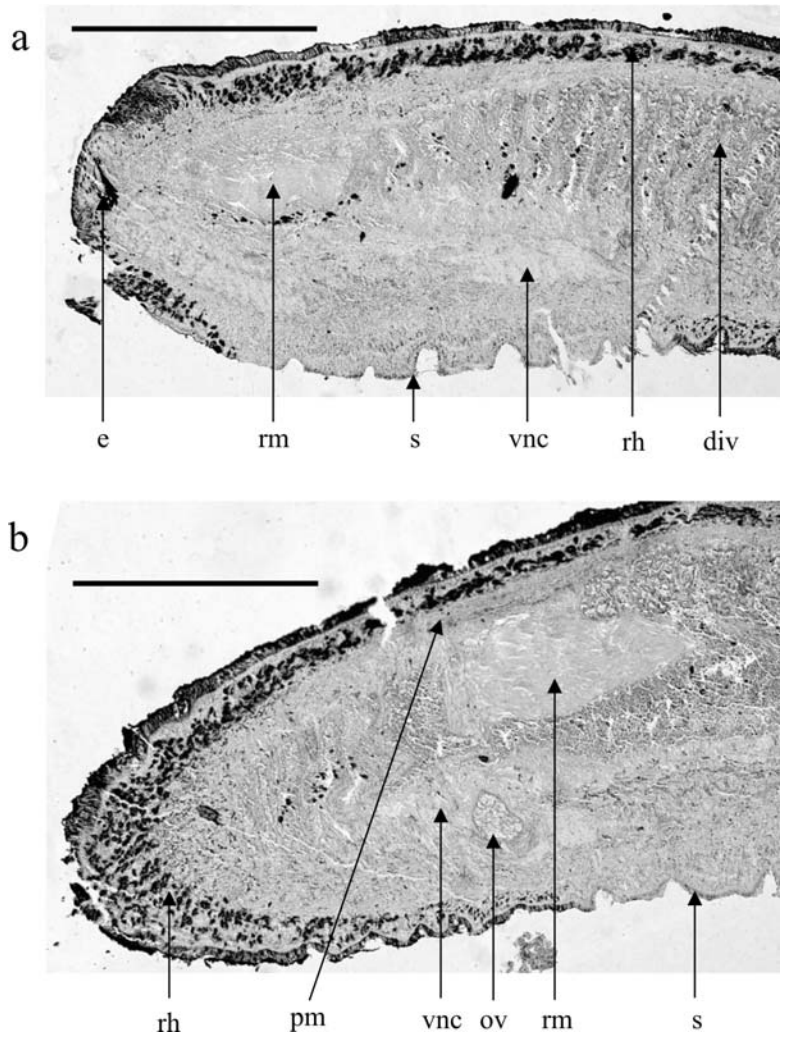

Fig. 3. *Othelosoma nyanga*. Longitudinal sections of the anterior end through (**a**) one eye, and (**b**) one of the ovaries. Scale bars = 1 mm. See Methods for a key to abbreviations.

strongly contracted and curved ventrally, so much so that the anterior overlaps the posterior. The anterior tip has a small T-shaped depression and the body has fine circular creases, indicating strong longitudinal contraction (Fig. 2). They are roughly cylindrical, though width is slightly greater than height. No external markings or openings are visible in preserved worms, which are buff-coloured.

After clearing (Fig. 2), two black eye spots are visible close to the anterior end. Dorsally, a faint, narrow, dark midline is visible. The ventral creeping sole is about one quarter of body width. The pharyngeal aperture (mouth) is just over half way along the ventral surface. The gonopore is posterior to the mouth.

Anatomy from sections. Each eye is tubular, about 160 μm long by 50 μm wide, with a deep, black pigmented eyecup (Fig. 3a). There is a dorsal longitudinal retractor muscle (Fig. 3a,b) which inserts immediately dorsal and posterior to the eyes (causing the anterior depression). It runs dorsal to the anterior gut diverticulum to its posterior origin appears which appears to be dispersed 3–4 mm from the anterior end (posterior to the level of the ovaries) in the dorsal parenchyma (Fig. 3b). There is a very thin layer, only one or two fibres thick, of sub-epidermal longitudinal muscle. Neither in transverse nor longitudinal sections do there appear to be any sub-epidermal circular muscle fibres. There is a well-defined, annular region of

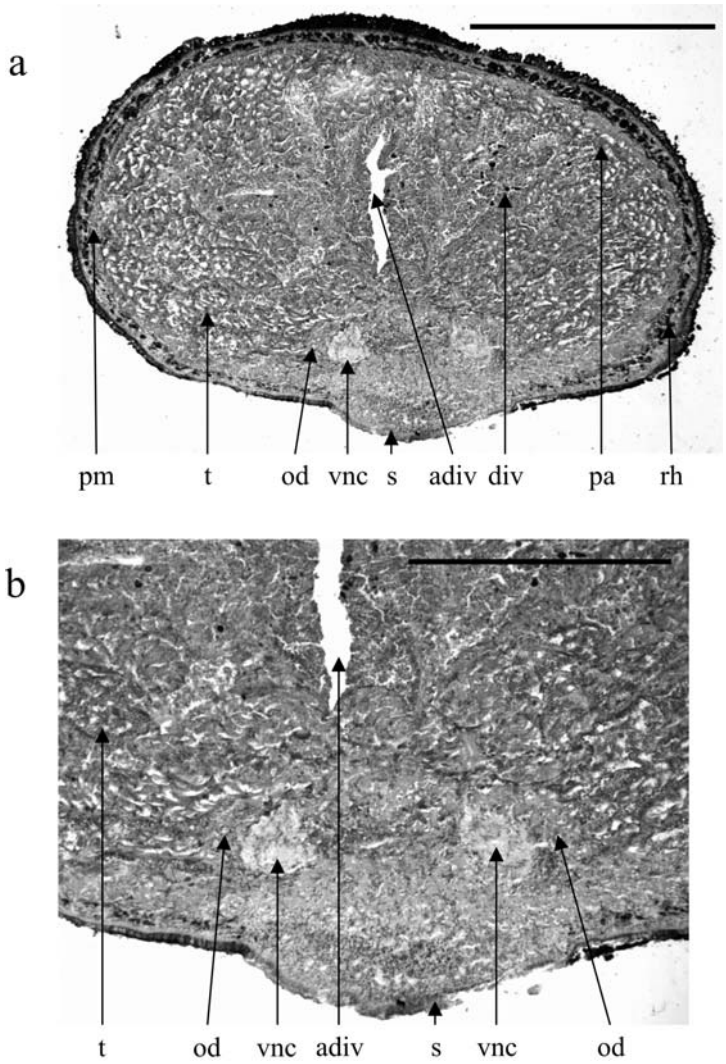

Fig. 4. *Othelosoma nyanga*. Transverse sections anterior to the pharynx; **a**, entire transverse section (scale bar = 1 mm); **b**, enlarged ventral region (scale bar = 0.5 mm). See Methods for a key to abbreviations.

parenchymal longitudinal and circular muscle fibres some distance in from the epithelium, inside the layer of sub-epidermal rhabdites (Fig. 4a). The ventral creeping sole is narrow, forming a slight convexity in transverse sections (Fig. 4), and ciliated. The nervous system appears fused anteriorly, but becomes paired a short way posteriorly and for most of the body length (Figs 4, 5a). The anterior extremity of the gut is just posterior to the eyes. The gut is typically triclad, with a single anterior branch with numerous lateral diverticula and two posterior diverticula each with numerous lateral diverticula. The diverticula are inside the parenchymal musculature. The pharynx is cylindrical. The pair of ovaries are about 2 mm from the anterior end and below and lateral to the ventral nerve cord on either side (Fig. 3b). The ovovitelline ducts run laterally to the ventral nerve cords on either side (Figs 4, 5a). The ovovitelline ducts run posterior to the gonopore, turn dorsally and unite (Figs 6c, 7). Two further ducts leave this junction. A short duct runs forwards and opens into the common antrum (Figs 6c, 7). A longer duct (common ovovitelline duct) runs dorsally then posteriorly, squeezed between the dorsal surface of the posterior extension of the common antrum (above the distal end of the penis) and the ventral surface of the large bursa (Figs 6c, 7). This duct

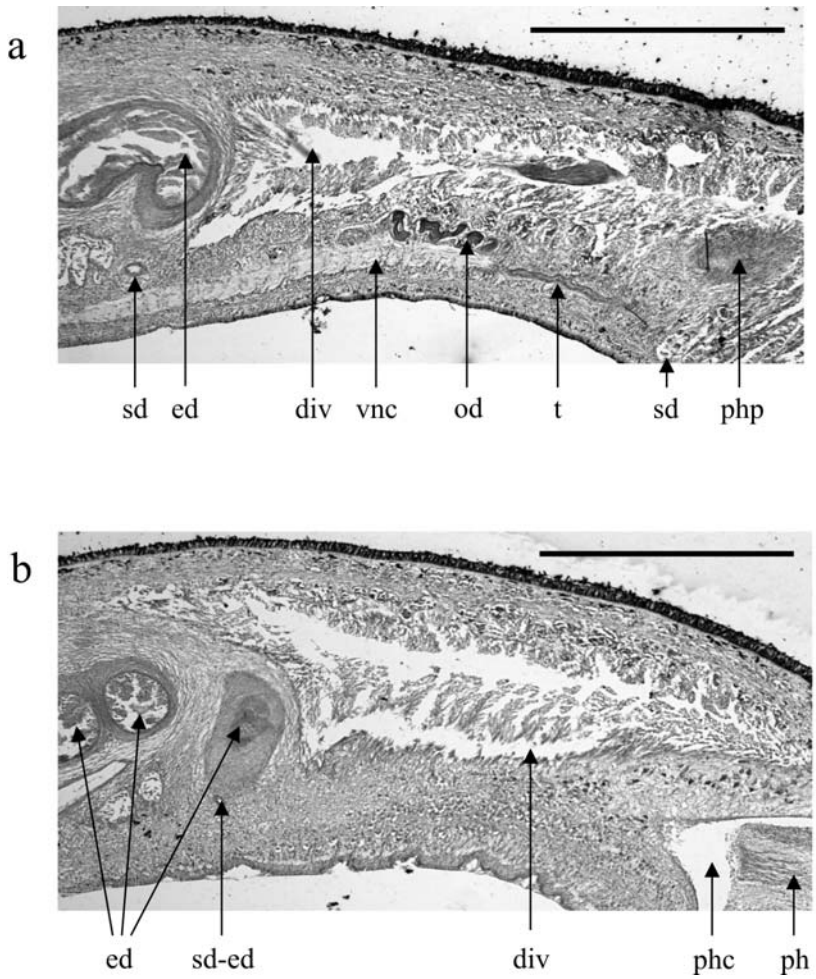

Fig. 5. *Othelosoma nyanga*. Longitudinal sections of the pharyngeal region to the base of the copulatory apparatus. Anterior end to the right. **a**, Section towards the lateral margin, through the oviduct and ventral nerve cord on one side; **b**, more medial section. Scale bars = 1 mm. See Methods for a key to abbreviations.

seems to make connection with the bursa near the bursa's posterior end (the opening is indistinct in sections), then curves downwards and forwards to open into a posterior extension of the common antrum opposite the end of the penis (Figs 6b, 7). Testes are numerous, ventral to and between the gut diverticula (Figs 4, 5a). Longitudinal sections show that the testes occupy the region from behind the ovaries to behind the pharynx almost to the copulatory apparatus (Fig. 5a). The sperm ducts are not discernible for most of their length, but probably run dorsal to each ventral nerve cord. Ventral to the pharyngeal pouch the sperm ducts expand and become convoluted to form a sperm storage organ (Figs 5a, 7). These two ducts reflect upwards and seem to separately discharge close together through very narrow ducts into the anterior base of the penis (Figs 6a, 7). The penis is long, about 2.5 mm in the sectioned specimen, and its posterior end extends into a posterior extension of the common antrum (Figs 6, 7). The ejaculatory duct of the penis is broad proximally, about 250 μm wide, and its internal surface has numerous projecting foliose processes for most of its length (Fig. 6). The distal 0.5 mm of the ejaculatory duct lacks these processes. The penis musculature consists of a dense sub-epidermal layer of enucleate muscle fibres about 20 μm thick. The outer (immediately sub-epidermal) 5 μm part of this layer consists of circular muscle fibres. The remaining 15 μm of this dense layer is longitudinal muscle. Inside this dense layer the tissue is open

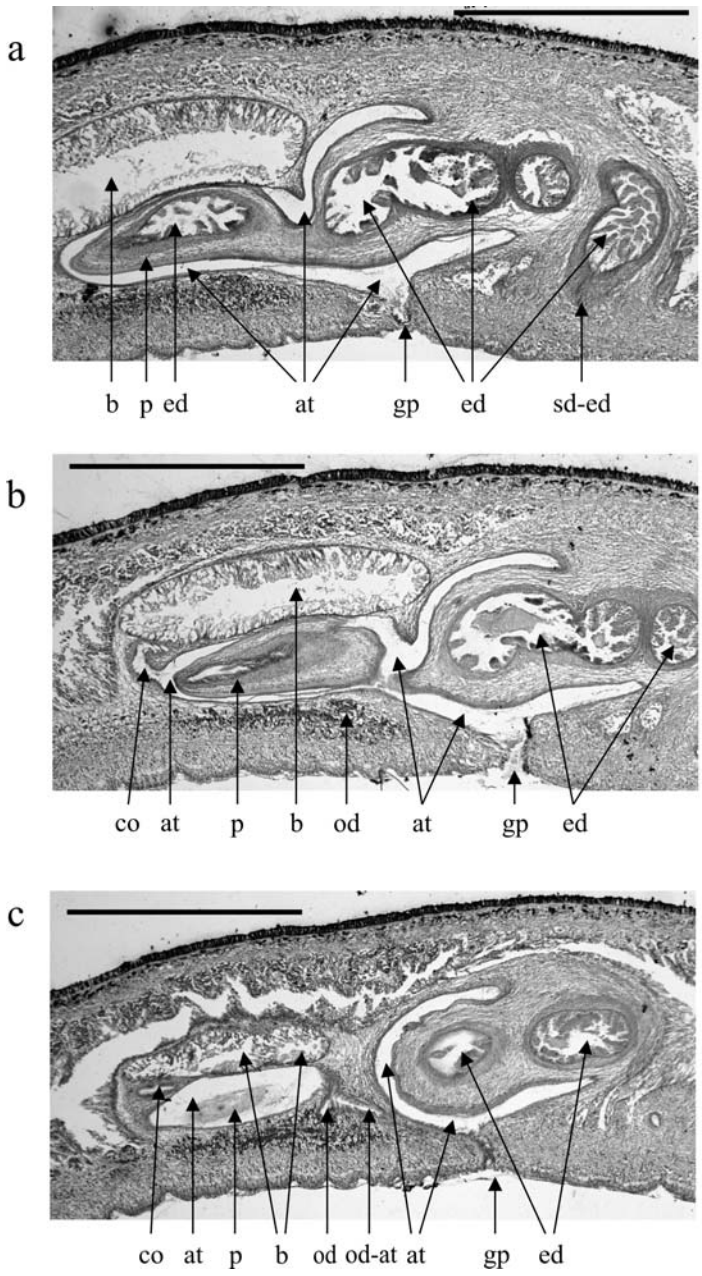

Fig. 6. *Othelosoma nyanga*. Longitudinal sections of the copulatory apparatus. Anterior end to the right. **a**, Medial section; (**b**) and (**c**) are further lateral and slightly posterior to (a). Scale bars = 1 mm. See Methods for a key to abbreviations.

and nucleate, but towards the central ejaculatory duct, the tissue becomes more dense and consists mainly of circular muscle fibres.

Habitat and natural history. Othelosoma nyanga was found at two sites close to the small Mare Dam, formed by the building of a wall across the Mare River, a small cold mountain stream arising in the foothills of the nearby Mount Inyangani, the highest point in Zimbabwe (altitude 2593 m a.s.l.). The area forms part of the Afromontane archipelago-like centre of regional endemism, the broken range of mountains running down the eastern

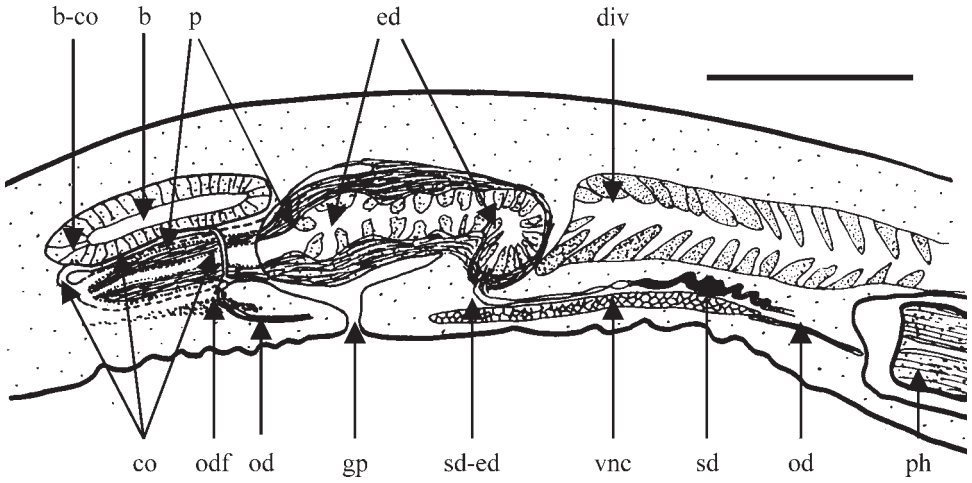

Fig. 7. *Othelosoma nyanga*. Composite, semi-diagrammatic, longitudinal section through the copulatory apparatus. Scale bar = 1 mm. See Methods for a key to abbreviations.

edge of the Great African Plateau. There are areas of extensive granites, with kaolitic soils. The vegetation is submontane (White 1983), with open rolling grassy hills but now invaded by introduced bracken and wattle and pine plantations. It receives the highest rainfall in Zimbabwe (about 1200 mm, mostly between December and March), is subject to mist and is cold in winter, especially at night.

The first specimen, collected on 23 December 1997, was found attached to the elbow of M.S.C. when she walked through damp, tallish mixed vegetation in a rather boggy area on the south bank of Mare Dam. Three further specimens were found, singly, by searching under dead wood stumps lying in long dense green grass on the northern bank, between 1 and 9 December 1999. November and December fall within the hot, wet season (November to March) in Zimbabwe. The under-surfaces of the logs were resting on deep, well-decomposed damp litter, with adhering soil and with many plant roots, fungi and invertebrates sheltering beneath them. The fourth specimen was under a large bulbous and fibrous root lying on litter and grass roots, after being dug up by baboons.

One damaged flatworm was kept alive for some time, regenerating a new front end. When offered earthworms to eat it simply crawled over them without feeding.

Remarks. The general anatomy is typical of terrestrial triclad planarians. The specimens are considerably contracted longitudinally which, in the preserved specimens resulted in the anterior depression, circular creasing and the convolutions in some of the reproductive ducts.

The specimens have an anterior retractor muscle, a well-defined annular zone of parenchymal muscle and a bursa, these being characteristic of the genus *Othelosoma*. However, there are differences between the arrangement of the female ducts in *O. nyanga* and those of other species of *Othelosoma*. The initial definition of *Othelosoma* by Gray (1869) noted particularly the anterior longitudinal retractor muscle. The generic definition as amended by Ogren & Kawakatsu (1989) (see above) includes 'very large seminal bursa which communicates by two openings (or by a common opening with two canals), a ductus vaginalis and a Beauchamp's canal, leading into the genital antrum'. In *O. nyanga* there appears to be only a single opening (though it is indistinct) to the bursa, which joins the common ovovitelline duct. However, two canals leave the point of fusion of the paired ovovitelline ducts. One leads anteriorly directly to the common antrum. The other (common ovovitelline duct) runs posteriorly, appears to connect with the bursa, then continues and opens into the posterior end of the antrum (opposite the end of the penis). Most other species of *Othelosoma* have a duct linking the bursa directly to the antrum (ductus vaginalis), completely separate from the ovovitelline duct system (Beauchamp's canal), though in some species the openings of these into the bursa are together and near the anterior of the bursa. One interpretation of the condition in *O. nyanga* is that the female duct anterior to the junction with the

bursa is homologous to Beauchamp's canal of other species, and that the short duct from the bursa to the posterior end of the antrum is homologous to the ductus vaginalis of other species. Thus, although the female ducts and bursal canal(s) are somewhat different from most other species of *Othelosoma, O. nyanga* does have a dorsal retractor muscle anteriorly, a bursa and complex female ducts, we place it in the genus *Othelosoma.*

Of the known African species of land planarians (Jones 2004), seven are predominantly yellow, thus might initially confused with *O. nyanga.* However, all have either one or three dorsal black or brown stripes visible in the living animals. Even though a faint dark mid-dorsal line is visible in preserved specimens, a line was not visible in the living specimens of *O. nyanga.* Marcus (1955) provided an anatomical key to the 21 species of *Othelosoma* whose copulatory apparatus was then known. Unsurprisingly, given the somewhat different arrangement of the female ducts in the present specimens, they do not key out to any of the 21 species.

The penis is exceptionally long compared to other species of *Othelosoma.* None of them have such a long penis nor such a long posterior extension of the antrum in which the penis is accommodated. This and the unusual arrangement of the female ducts means that *O. nyanga* is particularly well characterized and distinct from other species.

As Jones (2004) commented, nothing is known about the feeding habits or biology of any species of *Othelosoma.* The anterior retractor muscle and the strong parenchymal musculature suggest that *Othelosoma* might feed by attaching to prey, perhaps arthropods, and rapidly retracting, as does *Microplana termitophaga* (Jones *et al.* 1990, 1995; Cumming 1995; Jones & Cumming 1998), though that species lacks the anterior retractor muscle found in *Othelosoma.* As noted above, a live specimen ignored earthworms (which are the sole prey of some other land planarian species). Presumably *Othelosoma nyanga* reproduces as other land planarians, by copulation and development of an egg capsule containing several embryos, which is then released through the body wall. It may also be able to reproduce by fission.

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David Gibson and Tim Littlewood kindly allowed use of the digital photomicrography equipment in the Parasitic Worms Section, Zoology Department, Natural History Museum, London.

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